



DEFINITION - The scientific study of sight and the behaviour of light.

Introduction to Light

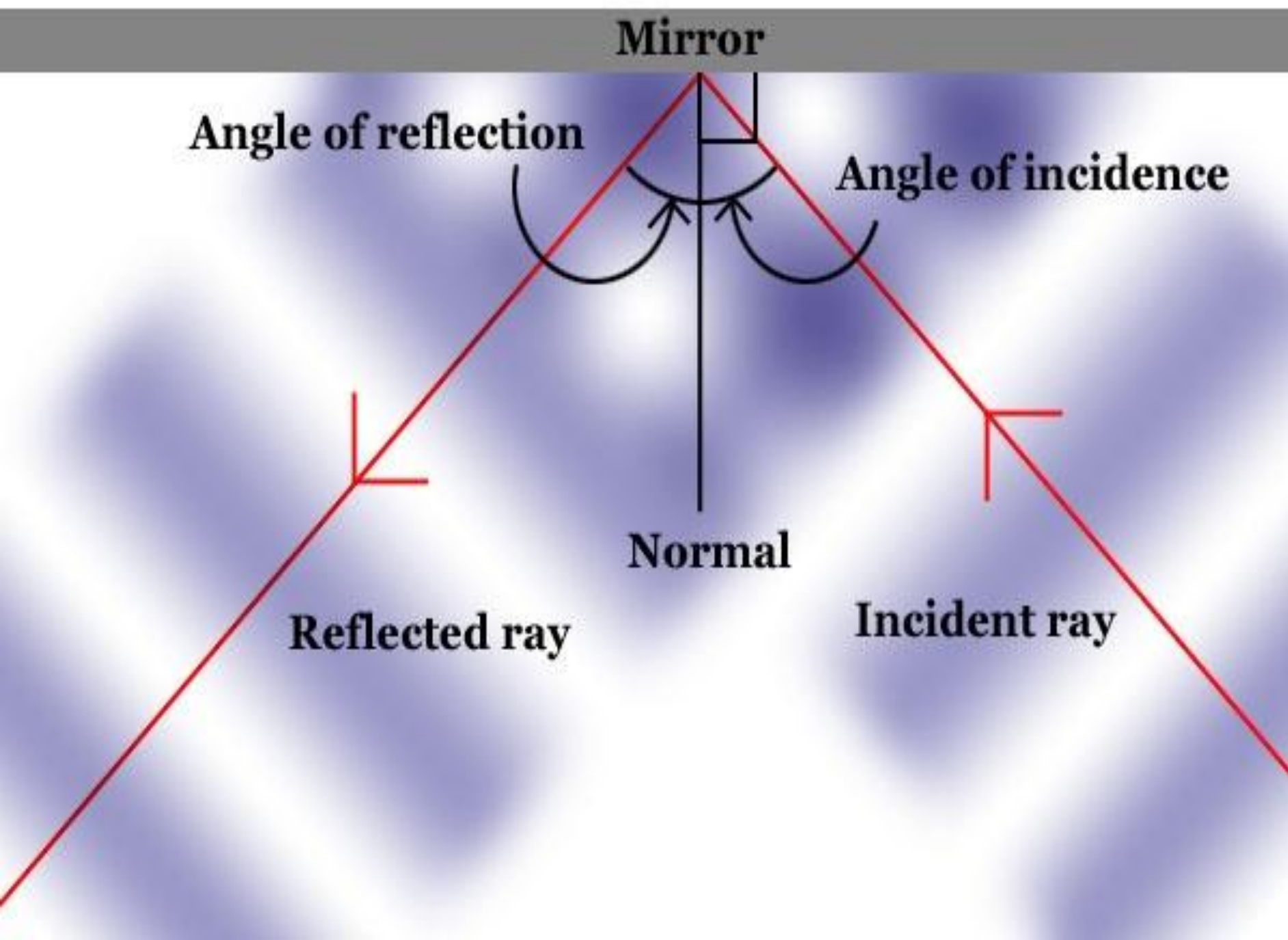
Name: _____ Class: _____ Date: _____

Light can come from many different sources including candles, light bulbs and electronic signs at night. Our most important source of light is the sun. Light is a form of energy that we can see. We often think of sunlight travelling in straight lines called rays. Light travels therefore it takes time to get from its source to our eyes. Light travels much faster than a person can walk or the speed of a car. Scientists have calculated that light travels at over 186,000 miles per second through air or space. It's so fast that it's hard to imagine. As a comparison, light can travel across North America and back over 30 times in 1 second. Light from the sun which is 93 million miles away reaches us on earth in only 8 minutes. Light from the next closest star which is so far away, takes over 4 years to reach us on earth. Light responds differently to different types of matter. For example glass in a window can easily allow light to pass through. Matter that you can clearly see through is called transparent. Water and air are other examples of matter that are transparent. Matter that does not allow any light to pass through is called opaque for example a stone wall or a tree. Matter that allows some light to pass through but also blocks other parts of the light is called translucent for example sunglasses or stained glass windows. The sun and fire are both natural sources of light. Light from the sun radiates which means it spreads out in all directions as rays. Light energy (unlike sound energy) does not require matter in order to travel therefore it is called radiation. Energy such as light that travels as radiation is often referred to as radiant energy. Scientists have developed technologies that can emit light. This source of man-made light is often referred to as artificial light, for example a light bulb. Light energy that is absorbed by a surface can be transferred into different forms of energy. For example thermal energy (eg. heat), electrical energy (eg. solar powered calculator) or chemical energy (eg. photosynthesis in a leaf).

Reflection and Luminosity

Name: _____ Class: _____ Date: _____

Since something opaque blocks light, shadows often result. Shadows are the absence of light. When light hits an object some of the light is reflected and some of the light is absorbed. The fact that light reflects from the surface of opaque objects is an important characteristic of light. Things that give off their own light are said to be luminous like for example the sun or a light bulb. Things that are luminous are direct sources of light. Most objects are non-luminous. For example if you turn off an artificial light in your room at night the room becomes dark. You can't see anything because all the other objects in the room are non-luminous which means they don't produce their own light. The light from the bulb radiates light in all directions reflecting light off all the non-luminous objects in the room. The books and people for example are revealed through reflective light. The moon is in fact not a direct source of light. The light that we see coming from the moon is actually reflected light from the sun which is hidden to us behind the planet at night. In the same way we can see reflected light from a book or magazine page because rays of light emitted from the lamp, reflect off the pages and into our eyes. How light reflects, depends on the kind of surface it hits. The page of a magazine may seem smooth and flat but if we were to zoom in and look at it very closely we would see that the page actual consists of many tiny bumps. Each ray of light strikes this rough and uneven surface and the reflected rays travel in many different directions. When light strikes a very smooth surface the rays of light hit the surface and all reflect in the same direction. When light reflects off this type of surface in such a regular and orderly way they form a mirror image that you can see. The best example of this would be a mirror on the wall in your home. You can also see these reflections outside in buildings made of glass or in the surface of a still pond.



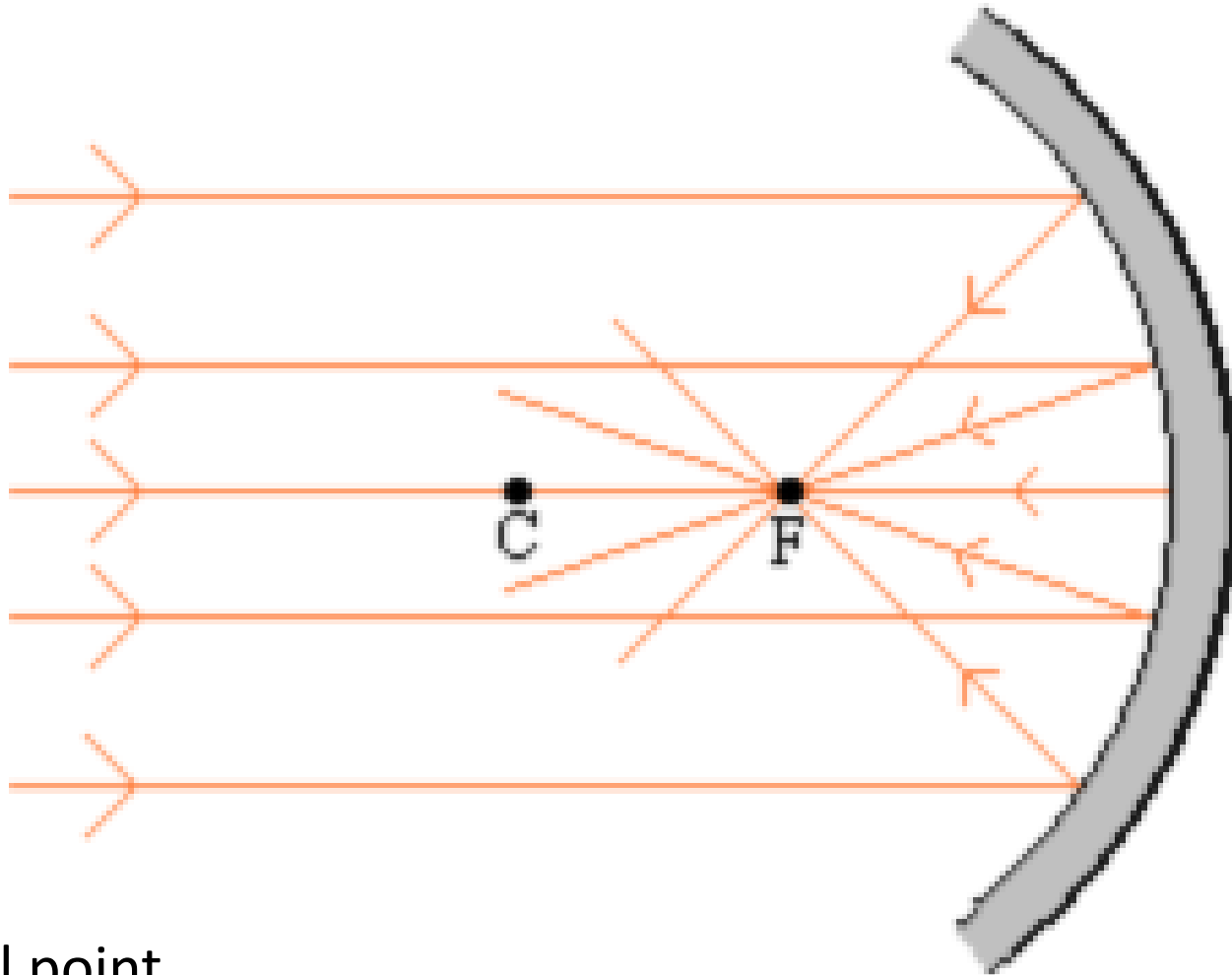
- INCIDENT RAY – light ray that strikes a surface
- REFLECTED RAY – light that is reflected from a surface
- NORMAL – perpendicular line to the reflecting surface
- ANGLE of INCIDENCE – angle between the incident ray and the normal (i)
- ANGLE of REFLECTION – angle between the normal and the reflected ray (r)

Law of Reflection

- LAW # 1 – The angle of reflection, r , is equal to the angle of incidence, i
- LAW # 2 – The incident ray, the normal and the reflected ray are all in the same *plane* (imaginary flat surface).

Concave and Convex Mirrors

Concave Mirror

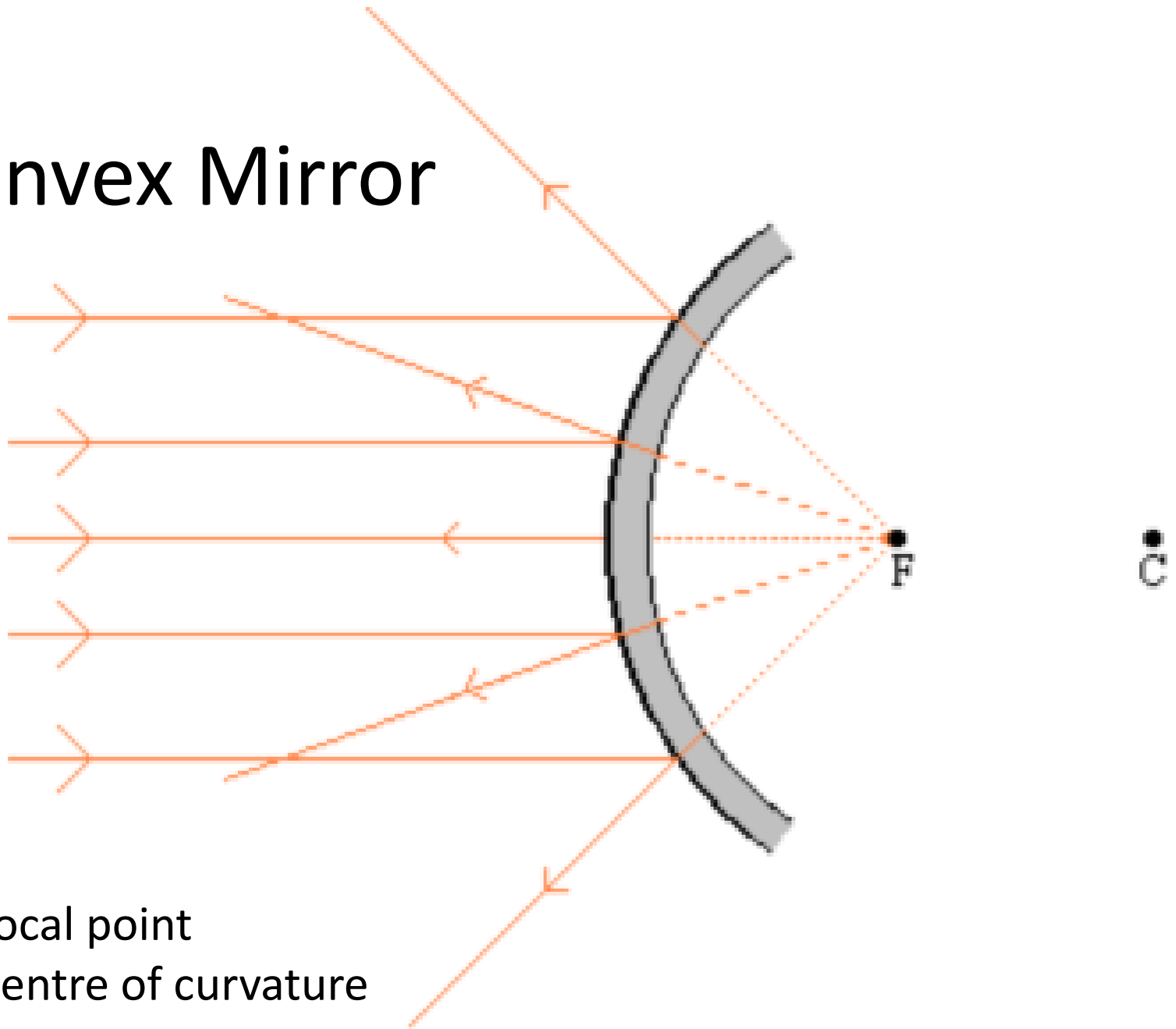


(F) Focal point

(C) Centre of curvature

- For concave mirrors, the law of reflection can be applied to find the location of an object. When the rays of light striking a concave mirror are parallel, they all converge at a point, as in the picture. This point is called the focal point of the mirror.

Convex Mirror



(F) Focal point

(C) Centre of curvature

- For convex mirrors, the law of reflection can be applied to find the location of an object. When the rays of light striking a convex mirror are parallel, they all appear to emerge from a point, as in the picture. This point is called the focal point of the mirror.



Refraction

Name: _____ **Class:** _____ **Date:** _____

Rays of light travel in straight lines. When rays reflect they change direction but continue to travel in straight lines. There are times however when light does not travel in straight lines but bends. Light can bend when light travels from one kind of transparent material to another. For example, light rays travel in straight lines through water which is transparent but when the light rays cross the boundary between the water and the air, they bend. In the example of the coin in the cup of water, some of the light rays are able to reach your eyes because of this bending of the light. This bending of light is called refraction. As a result, things that are underwater appear to be closer to the surface than they really are. The light rays reflected from something underwater refract or bend when they reach the surface of the water.

Refraction is the bending of light when it travels from one medium to another. The light refracts because it changes speed when it moves between materials that have different densities. Light usually travels more slowly in comparatively dense material. Light travels at 300,000 km/s in air.

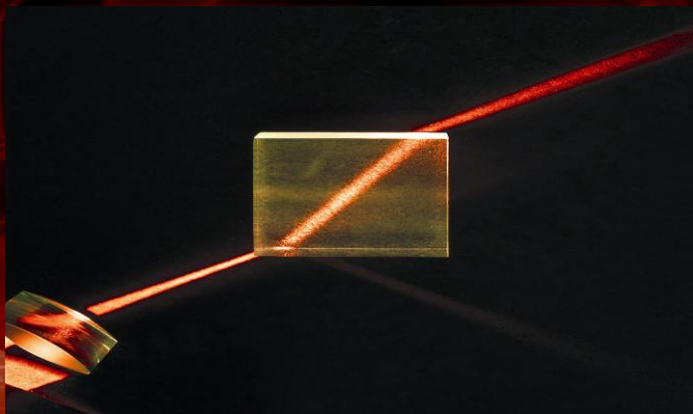
Refraction

D. Crowley, 2008

Refraction

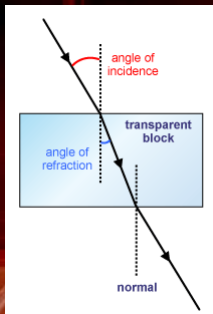


To know what refraction is, and why it happens



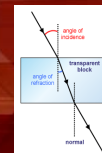
Refraction

- Light travels in straight lines through transparent and translucent **mediums** like air, water and glass.
- Light can bend at the **boundary** between two mediums with different **densities** - this is called **refraction**.
 - The light ray bends **towards the normal** as it enters a denser medium like water.
 - The light ray bends **away from the normal** as it leaves a denser medium like water.
 - The ray entering the glass block is parallel to the ray leaving the block, if the block has parallel faces.
 - A ray entering the block at 90° is **not refracted**.



Speed

- The speed of light rays depends on the medium they are travelling through.
- If light rays enter a different medium (e.g. travel from glass into air) the speed changes, causing the light to bend or refract.

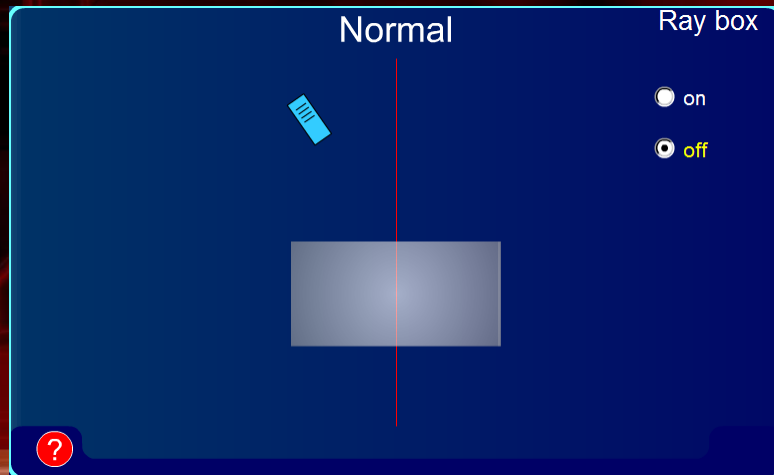


air = fastest

glass = slower

diamond = slowest

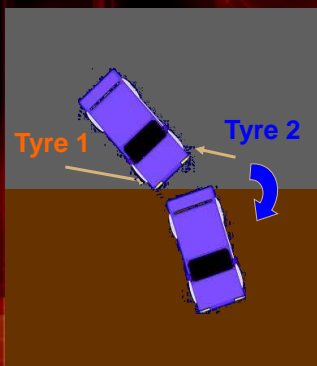
Refraction



Refraction



- Why does the light ray bend towards the normal when it enters the glass block, and then bend away from normal as it leaves?
- In the muddy field it slows down as there is more friction.
- If it enters the field at an angle then the front tyres hit the mud at different times.
- First to hit the mud is **tyre 1**, and will move more slowly than **tyre 2**. This causes the car to turn towards the normal.
- When the car leaves the mud for the road, **tyre 1** hits the road before **tyre 2** and this causes the car to turn away from the normal.

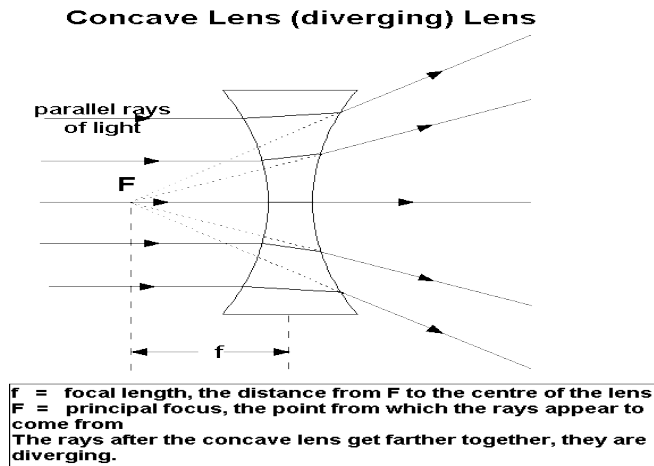


Lenses and Vision

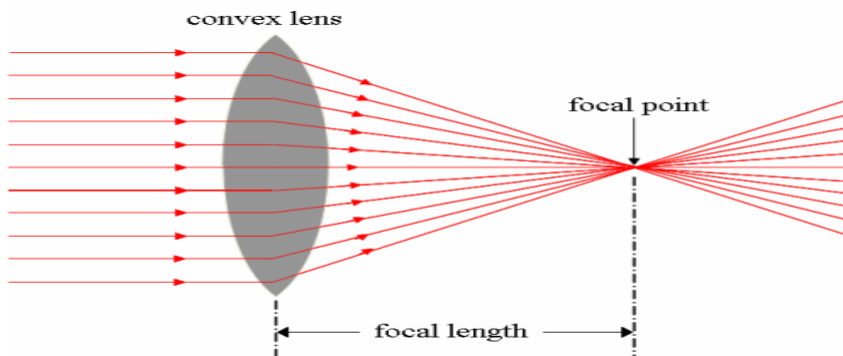


LENS – curved piece of *transparent* material
eg. glass or plastic

- **CONCAVE LENS** – thinner & flatter in the middle around the edges; rays of light *diverge* or *spread out*

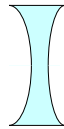


- **CONVEX LENS** – thicker in the middle than around the edges; rays of light *come together* or *converge*

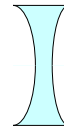




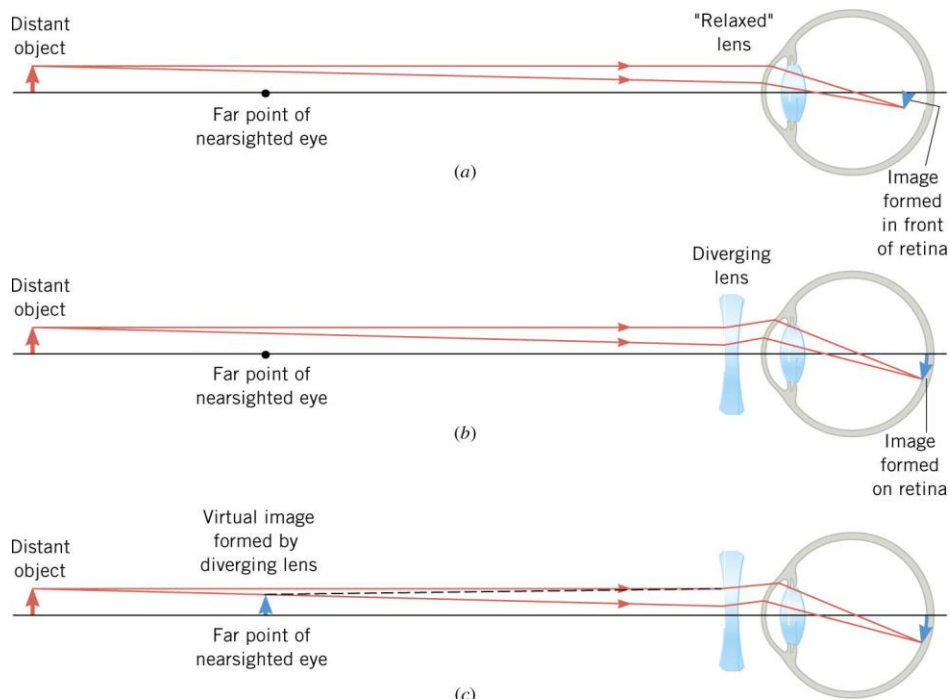
Someone who is Nearsighted cannot focus on far away objects. (Their far point is not at infinity.)



Nearsightedness can be corrected with **diverging** lenses



Here's how it works →





Someone who is Farsighted cannot focus on objects too near.



Farsightedness can be corrected with **converging** lenses



Here's how it works →

